JC10 Rec'd PCT/PTO 18 MAR 2002

FORM PTO-1390 (REV. 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY 'S DOCKET NUMBER: 298-157

U.S. APPLICATION NO. (If known, see 37 CFR 1.5: 10/088404

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/09001	SEPTEMBER 14, 2000	SEPTEMBER 16, 1999

TITLE OF INVENTION DEVICE AND METHOD FOR HIGH-SENSITIVITY RESOLUTION DETECTION

APPLICANT(S) FOR DO/EO/US Florian Beil, Martin Streibl and Achim Wixforth

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. [X] is attached hereto (required only if not communicated by the International Bureau). WO01/20781
   - b. [X] has been communicated by the International Bureau.
   - c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   - a. [X] is attached hereto. 2 PAGES OF COVER PAGE TRANSLATION, 16 PAGES SPECIFICATION, 7 PAGES OF CLAIMS, 1 PAGE OF DRAWINGS TRANSLATION,
   - b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [X] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   - b. [ ] have been communicated by the International Bureau.
   - c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   - d. [X] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [X] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). (7 PAGES OF CLAIMS)

Items 11 to 20 below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment. (with Marked-up Copy)
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [X] Other items or information: ENGLISH TRANSLATION OF FIGS 1-5, FORMS PCT/IPEA/416, PCT/IPEA/409, PCT/ISA/210 AND CITED REFERENCES

CERTIFICATION UNDER 37 C.F.R. § 1.10

I hereby certify that this correspondence and the documents referred to as enclosed are being deposited with the United States Postal Service on date below in an envelope as "Express Mail Post Office to Addressee" Mail Label Number __EL918809416US__ addressed to: Assistant Commissioner for Patents, Box PCT, Washington, D.C. 20231.

Dated: MARCH 18, 2002

George M. Kaplan

GEORGE M. KAPLAN

10088404 JC10 Rec'd PCT/PTO 18 MAR 2002

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/088404	PCT/EP00/09001	298-157

	CALCULATIONS	PTO USE ONLY
21. [X] The following fees are submitted: **BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):** Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .... **$1040.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .... **$890.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... **$740.00** International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) .... **$710.00** International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ $890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS	PTO USE ONLY
Total claims	27 - 20 =	7	x **$18.00**	$ $126.00	
Independent claims	2 - 3 =	0	x **$84.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$	

	CALCULATIONS	PTO USE ONLY
TOTAL OF ABOVE CALCULATIONS =	$ $1,016.00	
[X] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. +	$ -$508.00	
SUBTOTAL =	$ $508.00	
Processing fee of **$130.00** for furnishing the English translation later than [X] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	$	
TOTAL NATIONAL FEE =	$ $508.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$	
TOTAL FEES ENCLOSED =	$ $508.00	
	Amount to be refunded:	$
	charged:	$

a. [X] A check in the amount of $ $508.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. 04-1121 in the amount of $ ________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 04-1121. A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
ROCCO S. BARRESE, ESQ.

Dilworth & Barrese, LLP

333 Earle Ovington Blvd.

Uniondale, New York 11553

tel: (516) 228-8484

fax: (516) 228-8516

George M. Kaplan

SIGNATURE

GEORGE M. KAPLAN

NAME

28,375

REGISTRATION NUMBER

JC10 Rec'd PCT/PTO 18 MAR 2002

FORM PTO-1390 (REV. 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY 'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	298-157
	U.S. APPLICATION NO. (If known, see 37 CFR 1.5 10/088404

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/09001	SEPTEMBER 14, 2000	SEPTEMBER 16, 1999

TITLE OF INVENTION DEVICE AND METHOD FOR HIGH-SENSITIVITY RESOLUTION DETECTION

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Dated: ____MARCH 18, 2002__________

George M. Kaplan

GEORGE M. KAPLAN

10/088404 [stamp: JC13 Rec'd PCT/PTO 18 MAR 2002]

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/088404	PCT/EP00/09001	298-157

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George M. Kaplan

SIGNATURE

GEORGE M. KAPLAN

NAME

28,375

REGISTRATION NUMBER

[redacted]

10088404 .100202
Rec'd PCT/PTO 2 OCT 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Beil et al. Examiner:

Serial No.: 10/088,404 Group Art Unit:

Filed: September 14, 2000 Docket: 298-157

For: DEVICE AND METHOD FOR HIGH-SENSITIVITY RESOLUTION DETECTION Dated: October 2, 2002

Assistant Commissioner for Patents
Washington, D.C. 20231

SUPPLEMENTAL PRELIMINARY AMENDMENT

Sir:

Please enter the following Supplemental Preliminary Amendment in the above-identified application:

IN THE SPECIFICATION:

Change Page 3, line 6-Page 4, line 8 to read as follows:

- -Acoustic surface waves have been in use for the past 30 years for numerous applications in high-frequency technology and sensor technology. A surface wave can interact with external variables, as indicated by A. Wixforth in 1987 (Dissertation of A. Wixforth, University of Hamburg, 1987) for the interaction of surface waves with free charge carriers. In similar manner, according to U.S. 5,235,235 and U.S. 5,325,704, a mass-induced overlay can be detected in the substrate. The damping of a surface wave by mechanical loading by the substrate is described in U.S. 5,767,608 and U.S.

CERTIFICATION UNDER 37 C.F.R. § 1.10

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Dated: October 2, 2002

George M. Kaplan
George M. Kaplan

5,838,088. If a variety of surface wave transducers are used to generate various surface waves that pass through a passage of varying length, the location of the mechanical loading can be located by means of the differing delay times. Surface waves can be generated with the help of interdigital transducers (IDT) chiefly on piezoelectric substrates (R.M. White and F.W. Voltmer, Applied Physics Letters 7, pages 314 ff (1965)). Interdigital transducers have two electrodes with finger type extensions, which fingers interleave. The propagation qualities of surface waves depend on the finger interval and the phase velocity in the substrate material. According to EP 0 867 826 A2, such an interdigital transducer arrangement can be scanned via an antenna and a transmitter. Surface wave components are used, among other purposes, as dispersive high frequency filters. To increase the bandwidth, tapered interdigital transducers (TIDT) are used, as described in U.S. 4,908,542, U.S. 4,635,008, U.S. 5,831,492, and U.S. 5,831,494. In tapered interdigital transducers of thus type, the finger interval is not constant, it changes along the transducer axis.- -;

Change page 8, line 14 to page 9, line 5 to read as follows:

- -The use of tapered interdigital transducers has proved particularly advantageous. The frequency-determining finger interval of such tapered interdigital transducers changes along the axis of the surface wave transducer. The wavelength of a surface wave is at 0 approximation equal to the quotients of sound velocity and frequency of the surface wave. If at a known sound velocity the frequency input into the tapered interdigital transducer is determined, the surface wave is beamed only in a spatial range in which the interval of the individual fingers of the tapered interdigital transducer accords with the wavelength. In this way the spatial propagation range of

the surface wave can be determined very precisely.

Appropriate tapered interdigital transducers to receive the surface waves after their passage through the active surface lie opposite the tapered interdigital transducer for generating surface waves.- -;

Change page 12, line 6 to read as follows:

- -Fig. 1 the principal method of functioning of a tapered interdigital transducer, - -;

Change page 12, line 17 to page 13, line 2 to read as follows:

- -Fig. 1 illustrates in schematic form a tapered interdigital transducer 4 positioned, for example, on a piezoelectric substrate. It consists of electrodes 5, 7, which have finger-like extensions. In area 3 the finger-like extensions fit into electrodes 5 and 7. Via the feed 2 a voltage can be applied, at a desired frequency, to electrodes 5 and 7. In the example illustrated, interval 8 of the individual fingers changes linearly from position X_0 to position X_n. In a deviation from the illustrated linear change, a complex function of the interval change can also be provided.- -; and

Change page 16, lines 6-10 to read as follows:

- -Fig. 3a shows another embodiment as an example. It provides for two interdigital transducer pairs 4, 6 and 104, 106. Transducer pair 4, 6 serves to generate and detect surface waves 1, while transducer pair 104, 106 serves to generate and reveal surface waves 101. Both transducer pairs are tapered interdigital transducers, as described with reference to Fig. 1 - -.

IN THE CLAIMS:

Amend Claims 1, 2, 5, 6, 18-20 and 23 as follows and add Claim 29:

1. Device for high-sensitivity resolution detection of an external variable with a substrate, comprising

– at least one generating device (4, 104) on the substrate for generating acoustic surface waves by application of an input frequency,

– at least one active surface (10, 110) that can be covered with acoustic surface waves by at least one generating device (4, 104) for interaction with an external variable,

– at least one receiving device (6, 106) on the substrate to receive the surface waves after their passage through the active surface (10, 110),

– where the at least one generating device (4, 104) designed in such a manner that the propagation range of the surface waves in question (1, 101) within the respective active surface (1, 110) changes with the height of the input frequency.

2. Device for high-sensitivity resolution detection of an external variable according to claim 1, in which the external variable includes a local magnetic field, local illumination (9, 11), local heating, and/or local mechanical stress of the substrate.

5. Device for high-sensitivity resolution detection of an external variable according to claim 1, in which at least one generating device (4, 104) includes a surface wave transducer in which the position of the surface wave beam input changes with the input high-frequency signal along its axis.

6. Device for high-sensitivity resolution detection of an external variable according to claim 5, in which the surface wave transducer for generating an acoustic

surface wave (1, 101) includes a tapered interdigital transducer (3) in which the frequency-determining finger interval (8) is not constant along the axis of the surface wave transducer.

18. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the surface wave (1, 101) phase altered by interaction with the external variable is evaluated at the respective input frequency.

19. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the change in intensity of the surface wave caused by the interaction with the external variable is evaluated at the respective input frequency.

20. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the change in the lag time of the surface wave (1, 101) caused by the interaction with the external variable is evaluated at the respective input frequency.

23. Method for high-sensitivity resolution detection of an external variable according to claim 22, in which the frequency ranges of the surface waves (1, 101) coming from various directions do not overlap.

29. Device for high-sensitivity resolution detection of an external variable according to claim 1, with at least two generating devices (4, 104) for generating acoustic surface waves (1, 101), in which the respective active surfaces (10, 110) at least partially overlap, and at least two generating devices (4, 104) positioned in such manner that they can cover the overlapping area with surface waves from different directions and

at least two receiving devices (6, 106) on the substrate for receiving the respective surface waves after their passage through the respective active surfaces (10, 110).

REMARKS:

The claims in the application are 1-26, 28 and Claim 29 added by the present amendment.

Favorable consideration of the application as amended is respectfully requested.

Claim 29 introduced herein corresponds to Claim 8 amended to depend from Claim 1. Claims 2, 5, 6 and 18-20 have been amended to more accurately reflect an English translation from the original German text. In this regard, the specification has been amended at the appropriate locations.

More particularly, Claim 6 has been amended to recite that the interdigital transducer 3 is tapered, as shown in Fig. 1. Claim 2 has been amended to recited that the external variable includes a local magnetic field as described at page 18, line 8 of the specification. Claim 5 has been amended to recite that the position of the surface wave beam changes with the input frequency as described at page 16, line 11 of the specification. Recitation in claims 18-20 has been clarified as described in the inventive methods herein with the word - -comprising- - inserted into independent Claim 1 and spelling in Claim 23 corrected.

A marked-up copy is enclosed together with the requisite fee for the additional claim introduced herein.

Early favorable action is earnestly solicited.

Respectfully submitted,

George M. Kaplan
Registration No.: 28,375
Attorney for Applicant(s)

DILWORTH & BARRESE, LLP
333 Earle Ovington Blvd.
Uniondale, New York 11553
(516)228-8484

10/088404
JC10 Rec'd PCT/PTO 18 MAR 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Beil et al.
Examiner:

Serial No.: Not yet assigned
Group Art Unit:

Filed: Herewith
Docket: 298-157

For: DEVICE AND METHOD FOR HIGH-SENSITIVITY RESOLUTION DETECTION
Dated: March 18, 2002

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Please enter the following Preliminary Amendment in the above-identified application:

IN THE SPECIFICATION:

Page 3, underneath the title insert - -BACKGROUND OF THE INVENTION- -;

Page 4, between line 8 and 9 insert - -SUMMARY OF THE INVENTION- -;

Change lines 12-16 to read as follows:

- -This task is performed with a device for high-sensitivity resolution detection of an external variable, said device having the characteristics described herein, or a method for high-sensitivity resolution detection of an external variable, said method having the characteristics described herein. Particular embodiments of the device or the method are also described herein.-;

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Dated: March 18, 2002

George M. Kaplan

Page 6, between lines 3 and 4 insert - -BRIEF DESCRIPTION OF THE DRAWINGS- -; and

between lines 16 and 17, insert - -DESCRIPTION OF THE PREFERRED EMBODIMENTS- -.

IN THE ABSTRACT:

Insert the English abstract found on the cover page of WO01/20781 in its entirety at the appropriate location.

IN THE CLAIMS:

Cancel Claim 27 without prejudice, amend Claims 4, 5, 8-10, 12, 13, 17-22, 24 and 25 as follows and add Claim 28:

4. Device for high-sensitivity resolution detection of an external variable according to claim 1, in which the variable reacting with the acoustic surface waves (1, 101) is transmitted through local stresses in at least one portion of the substrate.

5. Device for high-sensitivity resolution detection of an external variable according to claim 1, in which at least one generating device (4, 104) includes a surface wave transducer in which the position of the surface wave beam input changes with the stored high-frequency signal along its axis.

8. Device for high-sensitivity resolution detection of an external variable according to claim 7, with at least two generating devices (4, 104) for generating acoustic surface waves (1, 101), in which the respective active surfaces (10, 110) at least partially overlap, and at least two generating devices (4, 104) positioned in such manner that they can cover the overlapping area with surface waves from different directions and

at least two receiving devices (6, 106) on the substrate for receiving the respective surface waves after their passage through the respective active surfaces (10, 110).

9. Device for high-sensitivity resolution detection of an external variable according to claim 8, in which the variable areas of the respective locally-changing frequency-determining finger intervals (8) of at least two generating devices do not have common values.

10. Device for high-sensitivity resolution detection of an external variable according to claim 1, with a radio receiving device for receiving a radio frequency for frequency-dependent input into at least one generating device (4, 104) and a second device for emitting a frequency signal dependent on the signal received from the receiving device (6, 106) for receiving surface waves (1, 101) after their passage through the active surface (10, 110),

in such manner that the device can be radio-scanned.

12. Spectrometer arrangement with a component for wavelength-dependent deflection of a light beam and a device for high-sensitivity resolution detection according to claim 1 for detection of the light beam deflection direction.

13. Imaging device with a device according to claim 1, and
an evaluation device for converting the output signal of the device into an image of the active surface (10, 110) under the influence of the external variable by means of image processing methods.

17. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the external variable is transmitted by means of local stresses in the substrate.

18. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the surface wave (1, 101) phase altered by interaction with the external variable is evaluated by the frequency in each case.

19. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the change in intensity of the surface wave through the interaction with the external variable at the frequency in each case is evaluated.

20. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the change in the lag time of the surface wave (1, 101) through the interaction with the external variable at the frequency in each case is evaluated.

21. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the input frequency during a measuring cycle is changed in such a manner that the active surface (10, 110) of the substrate is covered through the change in input frequency.

22. Method according to claim 14, in which surface waves (1, 101) from a variety of directions are passed through the active area (10, 110).

24. Method for high-sensitivity resolution detection of an external variable according to claim 22, in which the measured signals are evaluated with tomographic image processing methods.

25. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the acoustic surface waves (1, 101) are generated through beaming of a radio frequency into an antenna connected with at least one generating device (4, 104) for generating the acoustic surface (1, 101), and

the acoustic surface waves (1, 101) are received by a receiving device (6, 106) which includes a transmitter that emits a frequency signal, so that the high-sensitivity resolution detection can be scanned wirelessly.

28. Method for high-sensitivity resolution detection of an external variable, in which acoustic surface waves (1, 101) are sent in at least one direction through an active area (10, 110) of a substrate and are detected, whereupon surface waves of various frequencies pass through other areas of the active surface (10, 110),

at least one part of the active surface (10, 110) is caused to interact locally with the external variable, and

a change of parameters of the surface waves (1, 101) is detected through this interaction,

with a device for high-sensitivity resolution detection of an external variable with a substrate, of

at least one generating device (4, 104) on the substrate for generating acoustic surface waves by application of an input frequency,

at least one active surface (10, 110) that can be covered with acoustic surface waves by means of at least one generating device (4, 104) for interaction with an external variable,

at least one receiving device (6, 106) on the substrate to receive the surface waves after their passage through the active surface (10, 110),

where the at least one generating device (4, 104) designed in such manner that the propagation range of the surface waves in question (1, 101) within the respective active surface (10, 110) changes with the height of the input frequency.

REMARKS:

The claims in the application are 1-27 and 28.

Favorable consideration of the application as amended is respectfully requested.

The claims have been amended to eliminate all multiple dependencies (a marked-up copy is enclosed). The specification has been amended for formal reasons with the abstract being formally inserted.

Early favorable action is earnestly solicited.

Respectfully submitted,

George M. Kaplan
George M. Kaplan
Registration No.: 28,375
Attorney for Applicant(s)

DILWORTH & BARRESE, LLP
333 Earle Ovington Blvd.
Uniondale, New York 11553
(516)228-8484

5/PRTS

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Device and Method for High-Sensitivity Resolution Detection

The invention concerns a device and a method for high-sensitivity resolution detection of an external variable with the help of acoustic surface waves.

Acoustic surface waves have been in use for the past 30 years for numerous applications in high-frequency technology and sensor technology. A surface wave can interact with external variables, as indicated by A. Wixforth in 1987 (Dissertation of A. Wixforth, University of Hamburg, 1987) for the interaction of surface waves with free charge carriers. In similar manner, according to U.S. 5,235,235 and U.S. 5,325,704, a mass-induced overlay can be detected on the substrate. The damping of a surface wave by mechanical loading by the substrate is described in U.S. 5,767,608 and U.S. 5,838,088. If a variety of surface wave transducers are used to generate various surface waves that pass through a passage of varying length, the location of the mechanical loading can be located by means of the differing delay times. Surface waves can be generated with the help of interdigital transducers (IDT) chiefly on piezoelectric substrates (R.M. White and F.W. Voltmer, Applied Physics Letters 7, pages 314 ff (1965)). Interdigital transducers have two electrodes with finger-type extensions, which

fingers interleave. The propagation qualities of surface waves depend on the finger interval and the phase velocity in the substrate material. According to EP 0 867 826 A2, such an interdigital transducer arrangement can be scanned via an antenna and a transmitter. Surface wave components are used, among other purposes, as dispersive high-frequency filters. To increase the bandwidth, tapped interdigital transducers (TIDT) are used, as described in U.S. 4,908,542, U.S. 4,635,008, U.S. 5,831,492, and U.S. 5,831,494. In tapped interdigital transducers of this type, the finger interval is not constant, it changes along the transducer axis.

It is the task of the within invention to facilitate, with a simple and compact structure, a high-sensitivity resolution measurement of an external variable on a very small spatial scale.

This task is performed with a device for high-sensitivity resolution detection of an external variable, said device having the characteristics of claim 1, or a method for high-sensitivity resolution detection of an external variable, said method having the characteristics of claim 14. Particular embodiments of the device or the method are the subject of sub-claims.

A device according to the invention and a method according to the invention for high-sensitivity resolution detection of the interactions of at least one acoustic surface wave with at least one external variable that influences the acoustic surface wave(s) through interaction in its propagation is characterized by the fact that the acoustic surface wave(s) is/are propagated through the use of at least one specially conceived surface

wave transducer according to input frequency at another position of the area of at least one active surface of the device used, and hence at least one position determination and at least one bit of information about the nature and strength of the pertinent interaction can be obtained via the frequency with which an interaction with the external variable in the transfer function of the surface wave transducer used is determined.

A device according to the invention for high-sensitivity resolution detection of an external variable has, for example, a piezoelectric substrate on which there is at least one device for generating acoustic surface waves through application of an input frequency. The device according to the invention has at least one active surface, positioned in such manner that it can be covered by at least one generating device with an acoustic surface wave for interaction with an external variable. The substrate also has at least one device for receiving the surface waves after passage through the active area. The surface wave generating device is designed in such manner that the propagation of the surface waves in the active surface changes with the input frequency.

In the method according to the invention, an acoustic surface wave is sent in at least one direction through an active area of a substrate and is detected. The active area is brought locally into interaction with an external variable. Various areas of the active surface are covered with surface waves of various frequencies. The change in the parameters of the surface waves through the interaction is detected.

In the device according to the invention and the method according to the invention, the spatial area covered by the surface wave in the active area depends on the

input frequency. If the connection between the input frequency and the propagation range of the surface wave is known, any frequency can be allocated to a propagation range. In this way the local range is imaged in the frequency domain. If a surface wave of specified frequency interacts with an external variable, the parameters of this surface wave change. This change can be detected. When the frequency of the detected surface wave is known, the nature and/or the strength of the interaction can be determined from this change. In the case of a known frequency that determines the propagation range, the location of the interaction can also be determined.

The device according to the invention can be concentrated on a single substrate, e.g., a chip, and it facilitates the measurement of local variables with a resolution in the micrometer range. It can be produced with, for example, appropriate lithographic processes or planar technology. With only one surface generating device, various areas of the active surface can be covered by the surface wave as a result of the frequency dependence. To cover an active area, an individual pair consisting of a surface wave generating device and a surface wave receiving device is sufficient. The structure is thus very easy and inexpensive to produce. It is very easy for measurement technicians to achieve control of the local area in which the surface wave is to propagate through the frequency.

The device according to the invention and the method according to the invention for high-sensitivity resolution detection of an external variable are suitable for all external variables that influence the propagation of the surface wave. The invention has proved

particularly suitable for high-sensitivity detection of local magnetic fields, local illumination, local heating and/or local mechanical stress. The interaction can thereby be effected between the surface wave and free load carriers in the substrate.

A local mechanical stress can be, for example, a pressure applied by a needle-shaped body on the substrate. Another application results from the positioning of micro-components on substrates. The substrate can include a device according to the invention that has an active surface, within which a micro-component is to be positioned on the substrate. The micro-component is then positioned on the substrate and exerts a local mechanical stress. This stress can be detected with the help of the device according to the invention and allows the exact position of the micro-component to be determined or verified. Such an application is particularly advantageous in the case of the integration of mechanical and/or optical and/or electrical components on substrates. For example, the exact position of a micro-mirror on a substrate for opto-electronics can be determined.

The interaction with the external variable leads to a damping of the surface wave or to a change in the acoustic velocity. From the frequency at which this damping or the change in acoustic velocity is detected, a conclusion can be drawn concerning the location of the interaction.

Another advantageous embodiment uses the device according to the invention or the method according to the invention for detection of a local mass-induced overlay. For this purpose a portion of the active surface is functionalized in such manner that it reacts

chemically or physically with external reagents. The mass-induced overlay then likewise changes the propagation qualities of the surface wave.

The frequency-dependent propagation range of the surface waves can be achieved with a device according to the invention, for example through a number of surface transducers that work at various frequencies and are positioned in such manner that they cover various areas of the active surface with surface waves. This can be achieved, for example, with an arrangement of interdigital transducers that have different finger intervals and are thus suited to generating surface waves of varying frequency. Accordingly, a number of interdigital transducers adjusted appropriately are provided on the substrate to receive the surface waves.

The frequency-dependent propagation range of the surface waves can also be established by a surface wave transducer that, depending on a stored high-frequency signal, generates an acoustic surface wave at another position along its axis.

The use of tapped interdigital transducers has proved particularly advantageous. The frequency-determining finger interval of such tapped interdigital transducers changes along the axis of the surface wave transducer. The wavelength of a surface wave is at 0 approximation equal to the quotients of sound velocity and frequency of the surface wave. If at a known sound velocity the frequency input into the tapped interdigital transducer is determined, the surface wave is beamed only in a spatial range in which the interval of the individual fingers of the tapped interdigital transducer accords with the

wavelength. In this way the spatial propagation range of the surface wave can be determined very precisely.

Appropriate tapped interdigital transducers to receive the surface waves after their passage through the active surface lie opposite the tapped interdigital transducer for generating surface waves.

The frequency-determining finger interval of the interdigital transducer can be enlarged linearly or can follow a complicated function in order to achieve a larger or smaller resolution in certain local areas. Lastly, it is also possible to change the finger interval in stages.

In the case of an apparatus with a device for creating surface waves and a corresponding receiving device, the surface wave can be controlled, according to frequency, in one dimension of the propagation range. An apparatus in which two generating devices and two coordinated receiving devices are provided, which generate surfaces of various spatial directions, an active surface can be covered by any generating device. In this way the active surface can be measured two-dimensionally and a two-dimensional local resolution is possible.

Initially a frequency-dependent generating device can be provided to generate the surface waves and the interaction of these surface waves with the external variable at various frequencies can be detected, following which the second generating device generates frequency-dependent surface waves in the same manner.

It is particularly advantageous if the frequency ranges in which the generating devices generate position-dependent surface waves do not overlap. In an individual frequency sweep first one and then the other spatial direction of the active surface can be investigated for an interaction with the external variable.

In a separate embodiment of a method according to the invention or an apparatus according to the invention, provision can be made for wireless radio-scanning of the local interaction with an external variable through the use of at least one additional device.

A particularly advantageous use of the device according to the invention provides for an antenna for inputting a frequency signal into the generating device for generating a surface wave. In this way the generating device can be activated wirelessly. If the receiving device for the surface wave is linked with a transmitting unit., e.g. another antenna, and the signal can thus be scanned wirelessly.

An apparatus of such type can also be scanned completely wirelessly, a great advantage in measurement situations in which no external elements should be introduced. This can be the case in applications that must comply with strict hygiene conditions or if the measurement device or method is to be used in a hard vacuum.

If several devices according to the invention are used at various positions, it is advantageous if the wireless radio transfer also permits the individual devices to be identified. This can be achieved, for example, by appropriate coding methods for identifying the radio scannability of the given device.

The frequency used for radio scanning can thereby correspond directly with the frequency applied to the generating device in order to generate the surface waves in location-dependent manner.

The propagation qualities of the surface wave are changed through interaction with the external variable. For example, the change of phase, intensity, or travel velocity at the input frequency can be evaluated.

With the device according to the invention, for example, a miniature spectrometer or a camera component can be created.

If several surface-wave-generating devices equipped with appropriate receiving devices that send surface waves through the active surface at various angles are provided on an apparatus according to the invention, not only the position but also the shape of the interaction area can be measured. Image processing procedures known from tomography can be used here. Each surface wave transducer pair generates a silhouette shadow of the interaction area. With appropriate image processing software the shape of the interaction area can be generated. This is also advantageous when, for example, the interaction area consists of several non-contiguous individual sub-areas.

A similar effect can be achieved when the interaction area is first covered with a surface wave in one direction and the appropriate signal is recorded. The device is then turned at an angle in the plane of the surface wave without any change in the shape or position of the interaction area in the space. Then an additional detection measurement is performed. The surface waves of the second detection measurement then pass through the

active range in another direction. The same effect as when several transducer pairs are provided on the apparatus to cover the active surface from various directions with surface waves is thereby achieved.

The invention is explained in greater detail by means of preferred embodiments with the help of the attached figures, which show:

Fig. 1 the principal method of functioning of a tapped interdigital transducer,

Fig. 2a the schematic view of a one-dimensional detector according to the invention,

Fig. 2b an example of the frequency-dependent relative phase change upon use of a Fig. 2a embodiment according to the invention,

Fig. 2c the frequency-dependent phase signal of the device according to Fig. 2a with and without interaction,

Fig. 3a another embodiment of the device according to the invention,

Fig. 3b an example of the frequency-dependent transmission for the arrangement according to Fig. 3a, and

Fig. 4 the example of an application of an apparatus according to the invention as illustrated in Fig. 3a.

Fig. 1 illustrates in schematic form a tapped interdigital transducer 4 positioned, for example, on a piezoelectric substrate. It consists of electrodes 5, 7, which have finger-like extensions. In area 3 the finger-like extensions fit into electrodes 5 and 7. Via the feed 2 a voltage can be applied, at a desired frequency, to electrodes 5 and 7. In the example illustrated, interval 8 of the individual fingers changes linearly from position X_o to

position X_n. In a deviation from the illustrated linear change, a complex function of the interval change can also be provided.

Between frequency f_i and wavelength λ_i a surface wave consists in D [sic] approximation of the connection:

$f_i = v_s/\lambda_i$

A surface wave with wavelength λ_i is incited at position X_i at which the finger interval accords exactly with the wavelength. At constant sound velocity v_s, the radiant emission of surface wave 1 is determined through the frequency of the high-frequency signal input via connection 2 at position X_i.

A linear, one-dimension light sensor according to the invention is shown schematically in Fig. 2a. The number 4 designates the interdigital transducer used to generate the surface wave 1, as described in Fig. 1. The number 6 designates the interdigital transducer that serves to receive surface waves 1. Interdigital transducer 6 has in an area 13 engaging finger-like electrodes that serve for detection of surface waves 1. In the area in which the interval of the individual fingers of interdigital transducer 6 accords with the wavelength of the incoming surface wave, a signal with the frequency according to the above-indicated formula is incited. This signal can be tapped at connections 15 and passed on for evaluation.

The number 10 in Fig. 2a shows the area that with the help of interdigital transducer 4 can be covered with frequency-dependent surface waves. This corresponds

to the active area. The number 11 designates a scanning spot with which lighting 9 is generated.

Figures 2b and 2c illustrate signals that can be obtained as follows.

Between the two interdigital transducers 4 and 6, the sensor element is locally illuminated. In the case of a semi-conductor substrate, the incident photons generate free charge carriers in the illuminated area, which in turn interact with surface waves and thereby change the propagation qualities of said surface waves locally. In essence, the propagation qualities of only those surface waves that pass through interaction area 11 are affected. In the transfer function of the two interdigital transducers, this local interaction expresses itself as a definite irruption in the transmitted intensity. Since the position X_j of the generated surface wave depends on the beamed frequency, only one surface wave of specific frequency is influenced by the lighting. A frequency in accord with position X_j that leads to propagation of a surface wave that does not go through interaction area 11 is not influenced.

If the frequency is changed during a measurement cycle, the propagation position of the surface waves changes accordingly from x_o to x_n. The surface wave of varying frequency or wavelength so generated covers, among other things, the interaction area 11.

In Fig. 2c, curve 19 illustrates the phase of the surface waves that can be measured by interdigital transducers 4 and 6 at various frequencies. The switching on of a light 9 leads to an interaction of the surface waves with the lighting in the illuminated

area 11. In the frequency range that corresponds to the illuminated local area, the phase of the surface wave is changed, as shown in curve 21 of Fig. 2c.

Fig. 2b shows the relative phase change generated from curves 19 and 21 of Fig. 2c. In this illustration it is clearly evident that at a frequency of 750 MHz a phase change has taken place through the lighting. The 750 MHz frequency can be converted according to the above-indicated formula to a position, so that in at least one spatial direction the location of the lighting can be determined.

One possible application of such an device is, for example, a spectrometer. A spectrometer is used for the frequency-dependent or wavelength-dependent deflection of light. A conclusion can be drawn from the position deflection with respect to the energy of the beamed light. The position deflection can be determined in a very small local area with the help of the sensor element. From the frequency at which a phase change of the surface wave is detected, a conclusion can be drawn with respect to the position of the light incidence. From the position of the light incidence, on the other hand, a conclusion can be drawn with respect to the frequency or wavelength of the entering light.

Such a sensor element is advantageous in, for example, very small miniaturized experiments. Here the sensor element can also be integrated with a spectrometer element on a substrate structure. If the sensor element is designed to be radio-scannable, the spectrum of a burning gas can, for example, be monitored for environment-protection sensor purposes.

Instead of local lighting 9, a local magnetic field can also be applied, a local heating of the substrate within the active surface 10 can be detected, or a mechanical stress in a very limited spatial range. For example, a micro-touch screen can be created. A local mass-induced overlay can for example be detected through local chemical reactions in an interaction area 11 of active area 10.

Fig. 3a shows another embodiment as an example. It provides for two interdigital transducer pairs 4, 6 and 104, 106. Transducer pair 4, 6 serves to generate and detect surface waves 1, while transducer pair 104, 106 serves to generate and reveal surface waves 101. Both transducer pairs are tapped interdigital transducers, as described with reference to Fig. 1.

Depending on the input frequency, the surface waves are generated at different locations on the corresponding transducer 4, 104. In a frequency-change situation, active area 110 is covered. An interaction area 11, for example a scanning point, can thus be located two-dimensionally. The embodiment illustrated is organized in such manner that the finger intervals of the interdigital transducer 4 do not have an equivalent in the finger intervals of the interdigital transducer 104. The usable frequency ranges of the two interdigital transducers 4, 104 thus do not overlap. If a frequency sweep is made at connection 102 opposite ground connection 123, transducer 4 initially generates a surface wave 1, the position of which changes with the frequency. At a higher frequency that accords with the frequency range of interdigital transducer 104, it generates frequency-dependent surface waves at a different location. Receiver transducers 6 and 106 are

designed accordingly. Their output signal 115 facing ground connection 123 thus corresponds initially to the covering of active field 110 vertically and at higher frequency to the covering of mass area 110 horizontally.

This is shown in Fig. 3b, which shows the relative transmission of the surface waves. The frequency therefore rises from left to right. Curve 125 shows a plateau-like area 127 at lower frequencies, which corresponds to the usable frequency range of transducer 4. The plateau-like area 129 at higher frequencies corresponds to the usable frequency range of transducer 104 or 106. Transmission irruptions 131 and 133 arise through the interaction of the respective surface wave with the external lighting in interaction area 11. A conclusion can then be drawn with respect to the position of scanning point 11. This can occur for example through appropriate computer support.

Fig. 4 shows a computer-supported evaluation of the signal of Fig. 3b. It shows the image-processed signal 140, generated out of the frequency dependency of the relative transmission. Field 142 corresponds to the active area 110 of Fig. 3A. Number 144 clearly shows the receiving of the transmission of the surface waves in the two spatial directions, which accords with scanning spot 11. In this way a camera function can be realized.

Complex shapes of the interaction area can be measured with several transducer pairs or through several measurements in which the direction of the overall device has been changed compared to the interaction area. As in tomographic image processing methods, a evaluation can be made in order to determine the shape of the interaction area.

For example, an interaction area that consists of several independent sub-areas, e.g. an illumination with several scanning spots, can be measured.

Unlike frequency coding, transducer pairs 4, 104 or 6, 106 for the scanning of the various spatial directions can be separated by reason of the fact that one of the transducer pairs stands at a lesser distance to the other. In this way a time-delay difference that can serve for identification of the transducer pair is created between the different transducer pairs.

Needless to say, a local mass-induced overlay, a local magnetic field, a local mechanical stress, or local heating can be detected in the interaction area 11 if this external variable leads to a change in the propagation qualities of the surface waves.

For example, a very small chemical sensor or a "micro-touch screen" can be created. In the two-dimensional embodiment of Fig. 3a, the element can also be used, for example, in the manner of a quadrant photo diode.

With the device according to the invention or the method according to the invention a very keen high-sensitivity resolution detection of an external variable can thus be achieved with simple construction and with a number of application possibilities. When interdigital transducers are used as surface wave transducers, it is very easy to achieve radio scannability. The relative independence of the operating method from the choice of the input material used moreover permits a multiplicity of conceivable possibilities for use.

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Advalytix AG

Device and Method for High-Sensitivity Resolution Detection

Patent Claims

1. Device for high-sensitivity resolution detection of an external variable with a substrate, of
   - At least one generating device (4, 104) on the substrate for generating acoustic surface waves by application of an input frequency,
   - At least one active surface (10, 110) that can be covered with acoustic surface waves by means of at least one generating device (4, 104) for interaction with an external variable,

- At least one receiving device (6, 106) on the substrate to receive the surface waves after their passage through the active surface (10, 110),
- Where the at least one generating device (4, 104) designed in such manner that the propagation range of the surface waves in question (1, 101) within the respective active surface (1, 110) changes with the height of the input frequency.

2. Device for high-sensitivity resolution detection of an external variable according to claim 1, in which the external variable includes a local magnetic range, local illumination (9, 11), local heating, and/or local mechanical stress of the substrate.
3. Device for high-sensitivity resolution detection of an external variable according to claim 1, in which at least one portion of the substrate is functionalized in such manner that it is able to react chemically or physically with external reagents in the form of a mass-induced overlay.
4. Device for high-sensitivity resolution detection of an external variable according to one of claims 1 to 3, in which the variable reacting with the acoustic surface waves (1, 101) is transmitted through local stresses in at least one portion of the substrate.
5. Device for high-sensitivity resolution detection of an external variable according to one of claims 1 to 4, in which at least one generating device (4, 104) includes a surface wave transducer in which the position of the surface wave beam input changes with the stored high-frequency signal along its axis.

6. Device for high-sensitivity resolution detection of an external variable according to claim 5, in which the surface wave transducer for generating an acoustic surface wave (1, 101) includes a tapped interdigital transducer (3) in which the frequency-determining finger interval (8) is not constant along the axis of the surface wave transducer.

7. Device for high-sensitivity resolution detection of an external variable according to claim 6, in which at least one receiving device (6, 106) has a second surface wave transducer designed as a tapped interdigital transducer (13), in which the frequency-determining interval is not constant along the axis of the surface wave transducer.

8. Device for high-sensitivity resolution detection of an external variable according to one of claims 1 to 7, with at least two generating devices (4, 104) for generating acoustic surface waves (1, 101), in which the respective active surfaces (10, 110) at least partially overlap, and at least two generating devices (4, 104) positioned in such manner that they can cover the overlapping area with surface waves from different directions and

- At least receiving two devices (6, 106) on the substrate for receiving the respective surface waves after their passage through the respective active surfaces (10, 110).

9. Device for high-sensitivity resolution detection of an external variable according to claim 8 insofar as it is dependent on claim 7, in which the variable areas of the

respective locally-changing frequency-determining finger intervals (8) of at least two generating devices do not have common values.

10. Device for high-sensitivity resolution detection of an external variable according to one of claims 1 to 9 with a radio-receiving device for receiving a radio frequency for frequency-dependent input into at least one generating device (4, 104) and a second device for emitting a frequency signal dependent on the signal received from the receiving device (6, 106) for receiving the surface waves (1, 101) after their passage through the active surface (10, 110),

    in such manner that the device can be radio-scanned.

11. Device for high-sensitivity resolution detection of an external variable according to claim 10 with coding components for identifying the radio-scannable device.

12. Spectrometer arrangement with a component for wavelength-dependent deflection of a light beam and a device for high-sensitivity resolution detection according to one of claims 1 to 11 for detection of the light-beam deflection direction.

13. Imaging device with

    a device according to one of claims 1 to 11, and

    - an evaluation device for converting the output signal of the device into an image of the active surface (10, 110) under the influence of the external variable by means of image processing methods.

14. Method for high-sensitivity resolution detection of an external variable, in which

- acoustic surface waves (1, 101) are sent in at least one direction through an active area (10, 110) of a substrate and are detected, whereupon surface waves of various frequencies pass through other areas of the active surface (10, 110),
- at least one part of the active surface (10, 110) is caused to interact locally with the external variable, and
- a change of parameters of the surface waves (1, 101) is detected through this interaction.

15. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which the external variable includes a local magnetic range, a local illumination (9, 11) of the substrate, a local mechanical stress of the substrate, and/or a local heating of the substrate.

16. Method for high-sensitivity resolution detection of an external variable according to claim 14, in which at least one portion of the substrate is functionalized in such manner that it is able to react chemically or physically with external reagents and the external variable has a mass-induced overlay.

17. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 16, in which the external variable is transmitted by means of local stresses in the substrate.

18. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 17, in which the surface-wave (1, 101) phase altered by interaction with the external variable is evaluated by the frequency in each case.

19. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 18, in which the change in intensity of the surface wave through the interaction with the external variable at the frequency in each case is evaluated.

20. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 19, in which the change in the lag time of the surface wave (1, 101) through the interaction with the external variable at the frequency in each case is evaluated.

21. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 20, in which the input frequency during a measuring cycle is changed in such manner that the active surface (10, 110) of the substrate is covered through the change in input frequency.

22. Method according to one of claims 14 to 21, in which surface waves (1, 101) from a variety of directions are passed through the active area (10, 110).

23. Method for high-sensitivity resolution detection of an external variable according to claim 22, in which the frequency ranges of the surface waves (1, 101) coming from various direction do not have the same frequency at any time.

24. Method for high-sensitivity resolution detection of an external variable according to one of claims 22 or 23, in which the measured signals are evaluated with tomographic image processing methods.

25. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 24, in which the acoustic surface waves (1, 101) are generated through beaming of a radio frequency into an antenna connected with at least one generating device (4, 104) for generating the acoustic surface (1, 101), and

    the acoustic surface waves (1, 101) are received by a receiving device (6, 106) which includes a transmitter that emits a frequency signal,

    so that the high-sensitivity resolution detection can be scanned wirelessly.

26. Method for high-sensitivity resolution detection of an external variable according to claim 25, in which in addition an identification coding is transmitted wirelessly.

27. Method for high-sensitivity resolution detection of an external variable according to one of claims 14 to 26, with a device according to one of claims 1 to 11.

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(71) Anmelder *(für alle Bestimmungsstaaten mit Ausnahme von US)*: **ADVALYTIX AG** [DE/DE]; Schellingstrasse 4/IV, 80779 München (DE).

(72) Erfinder; und

(75) Erfinder/Anmelder *(nur für US)*: **BEIL, Florian** [DE/DE]; Erlerholz 9, 83714 Miesbach (DE). **STREIBL, Martin** [DE/DE]; Alte Sollerner Strasse 1B, 85238 Petershausen (DE). **WIXFORTH, Achim** [DE/DE]; Blutenburgstrasse 43, 80636 München (DE).

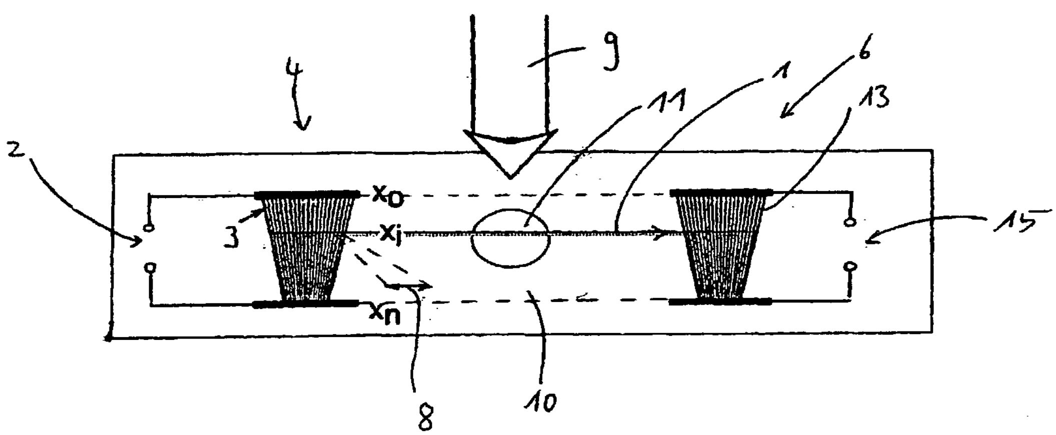
(74) Anwalt: **LORENZ SEIDLER GOSSEL**; Widenmayerstrasse 23, 80538 München (DE).

(81) Bestimmungsstaaten *(national)*: AE, AG, AL, AM, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CN, CR, CU, CZ, DM, DZ, EE, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, RO, RU, SD, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

[Fortsetzung auf der nächsten Seite]

(54) **Title:** DEVICE AND METHOD FOR HIGH-SENSITIVITY RESOLUTION DETECTION

(54) **Bezeichnung:** VORRICHTUNG UND VERFAHREN ZUR ORTSAUFGELÖSTEN DETEKTION



(57) **Abstract:** The invention relates to a device for the high-sensitivity resolution detection of an external variable, comprising a substrate, at least one device for generating acoustic surface waves by applying an input frequency, provided on said substrate, at least one active surface, which can be charged with the acoustic surface waves by the generating device, said surface waves interacting with an external variable, and at least one device for receiving the surface waves after they have passed through the interaction field, this device also being provided on the substrate. The surface wave generating device is configured in such a way that the range of propagation of the surface waves in the active surface changes with the input frequency. The invention also relates to a method for the high-sensitivity resolution detection of an external variable. According to said method, acoustic surface waves are sent out over an active area of a substrate and detected. Surface waves of different frequencies pass through other areas of the active surface. The active area is caused to interact locally with the external variable and a change in the parameters of the surface waves is shown by this interaction.

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Diagram Pages 1/5 through 5/5

1/5 Figure 1

2/5 Figure 2a

3/5 Figure 2b

Rel.
phase change
(deg.)

Fig. 2c

Phase of SAW signal (deg.)

Frequency (MHz)

4/5 Figure 3a

5/5 Figure 3b

rel. transmission
(10 dB/div.)

Figure 4

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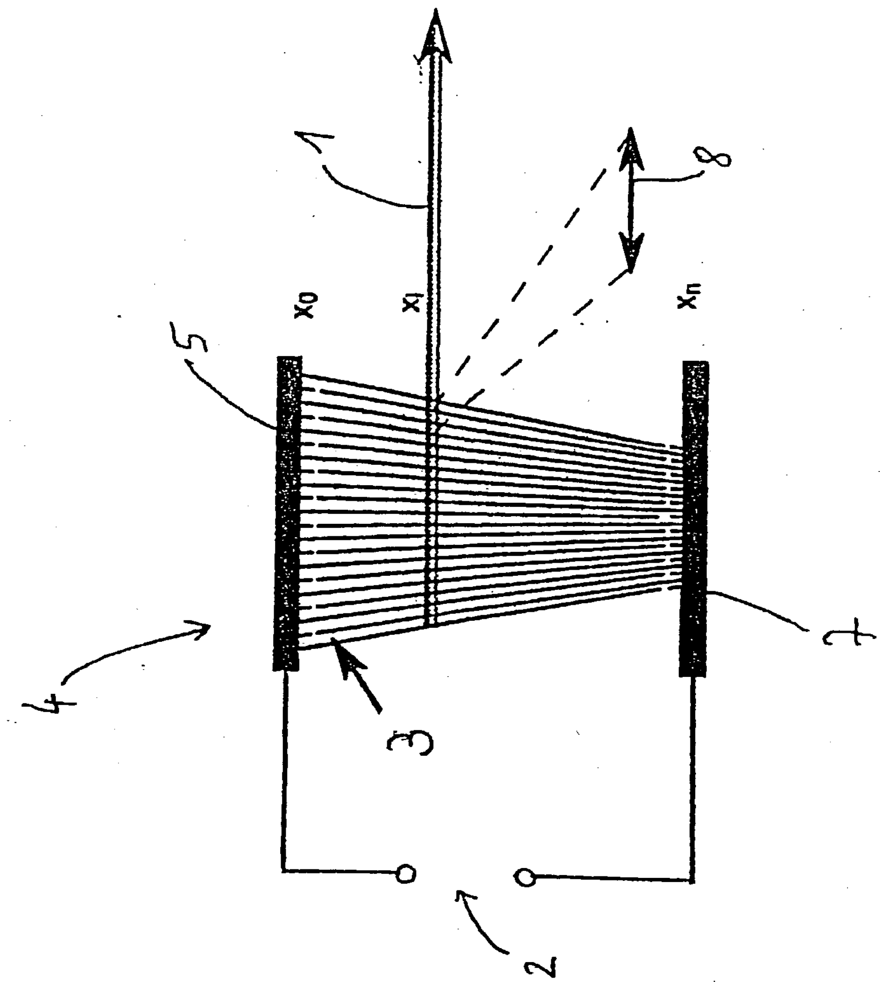

Figure1

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Figure2-a

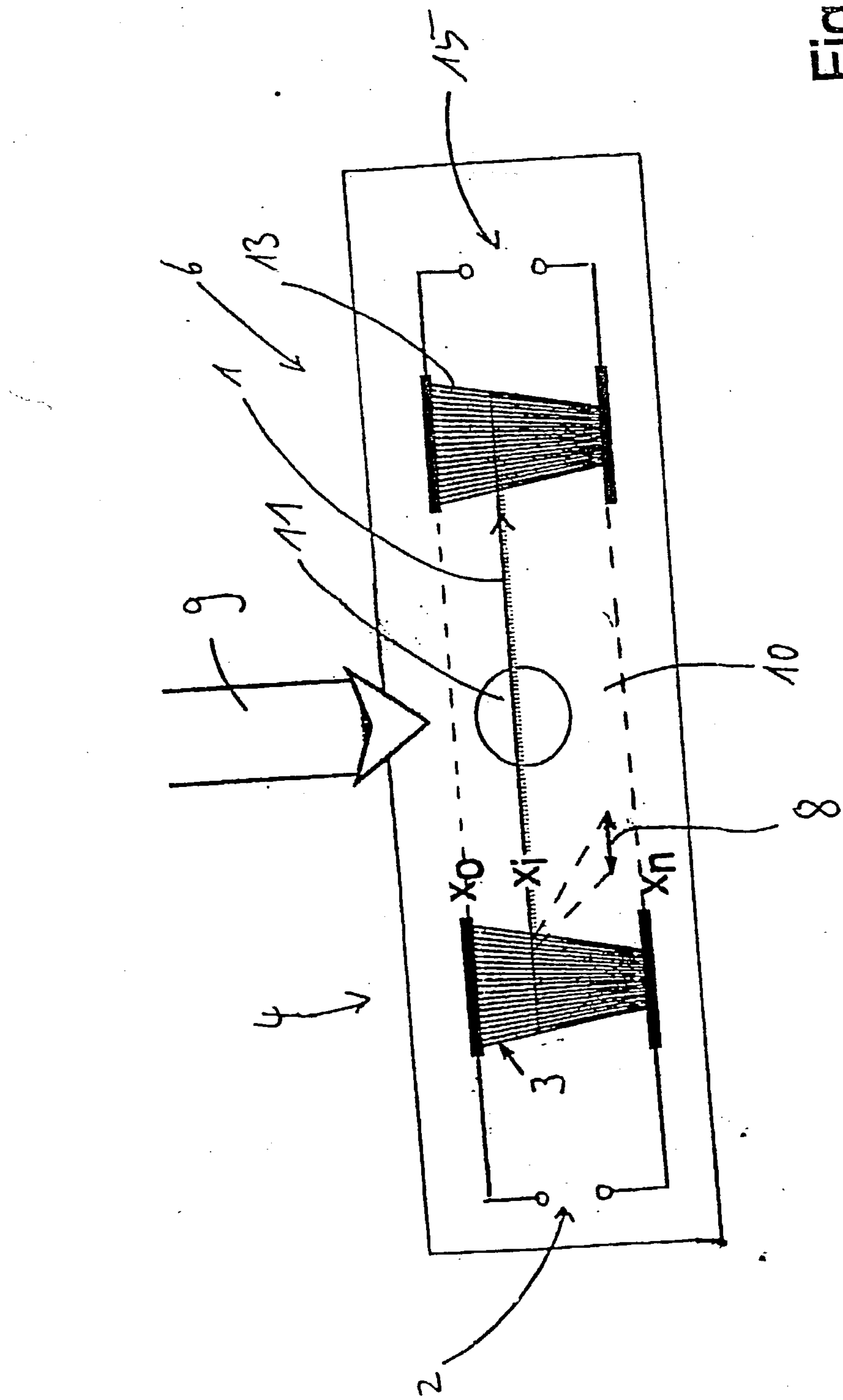

Fig. 2b

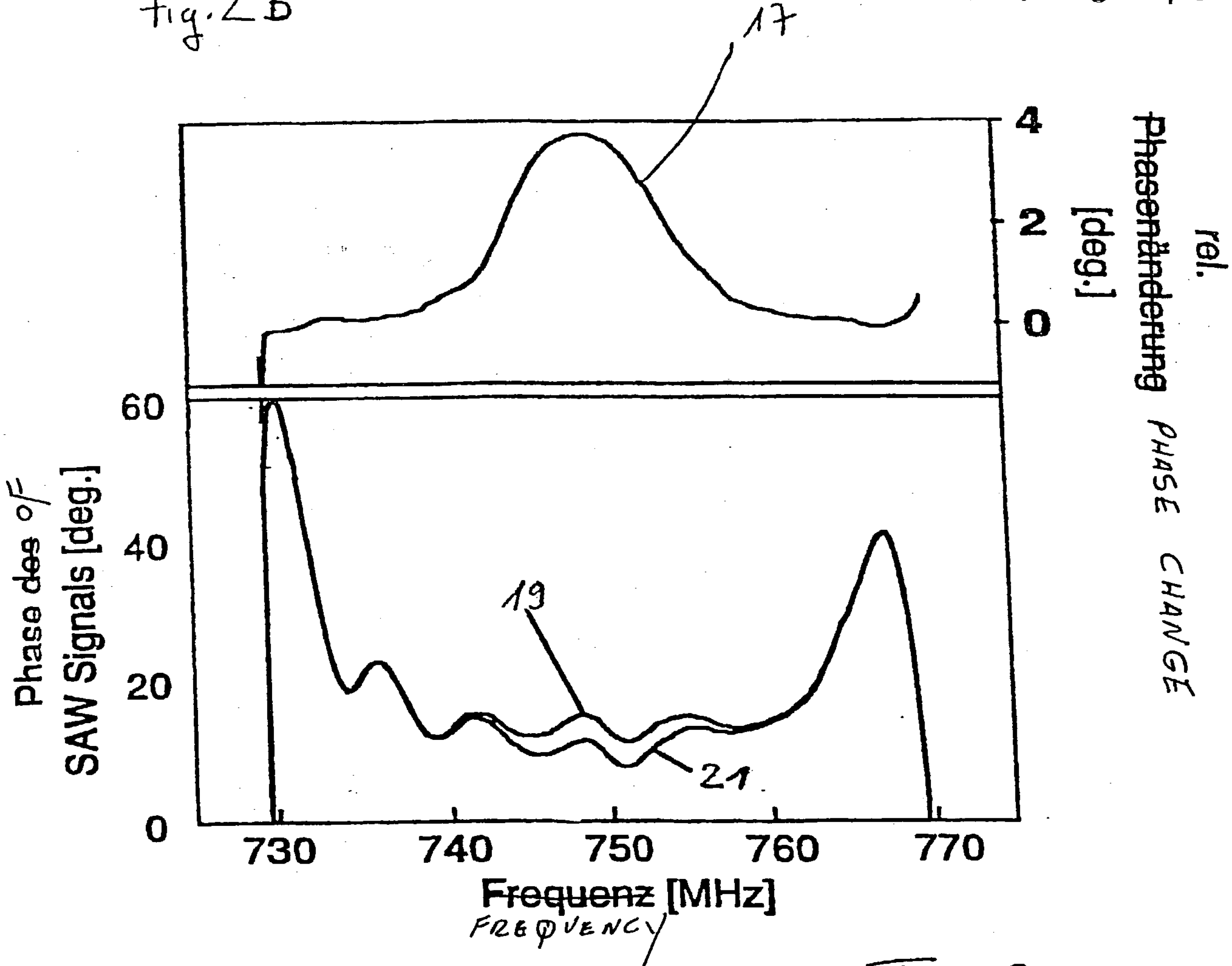
17
4
2
0
rel.
~~Phasenänderung~~
[deg.]
PHASE CHANGE
60
40
20
0
Phase ~~des~~ of
SAW Signals [deg.]
19
21
730
740
750
760
770
~~Frequenz~~ [MHz]
FREQUENCY

Fig. 2c

10/088404

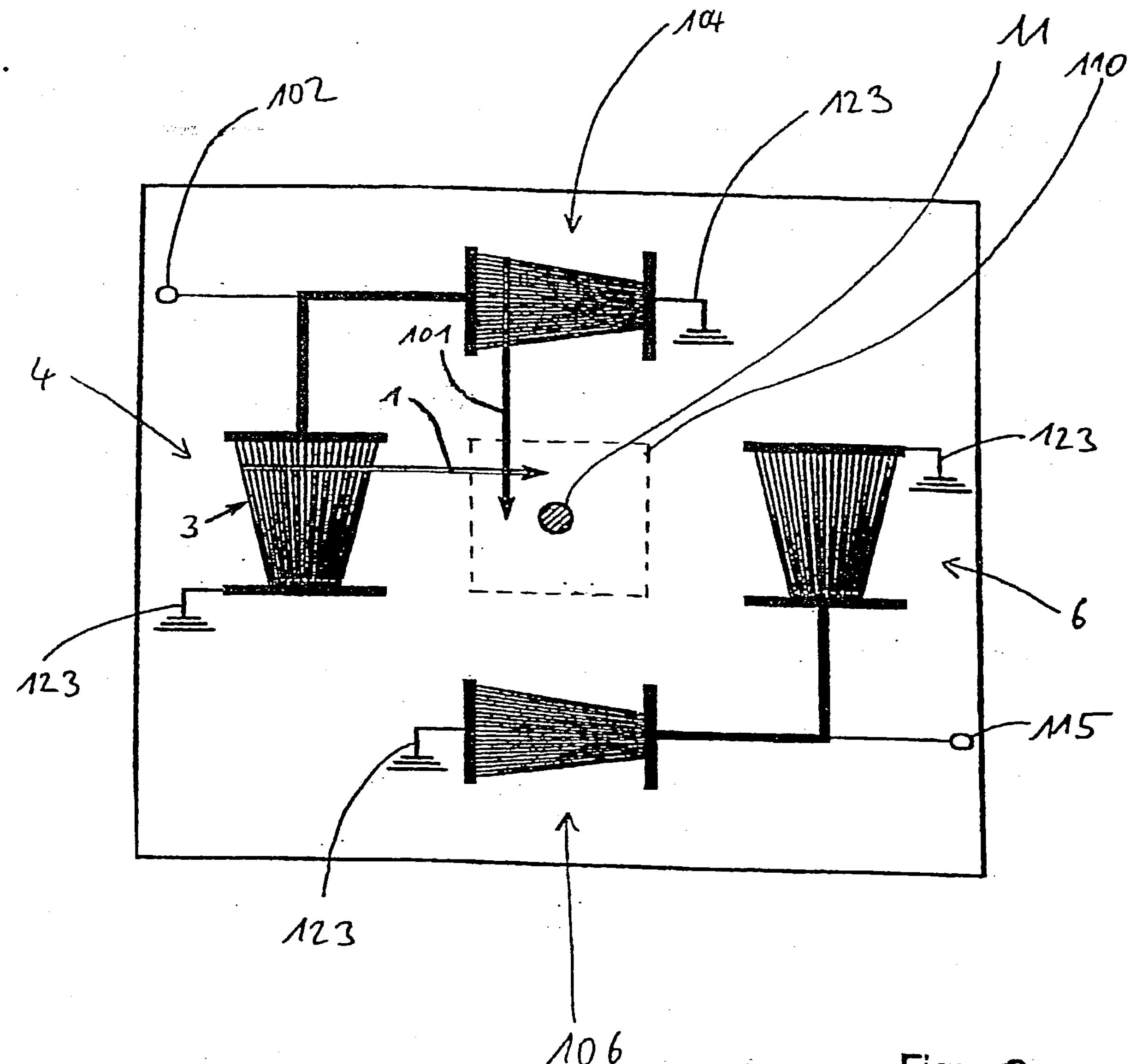

Figure3 a

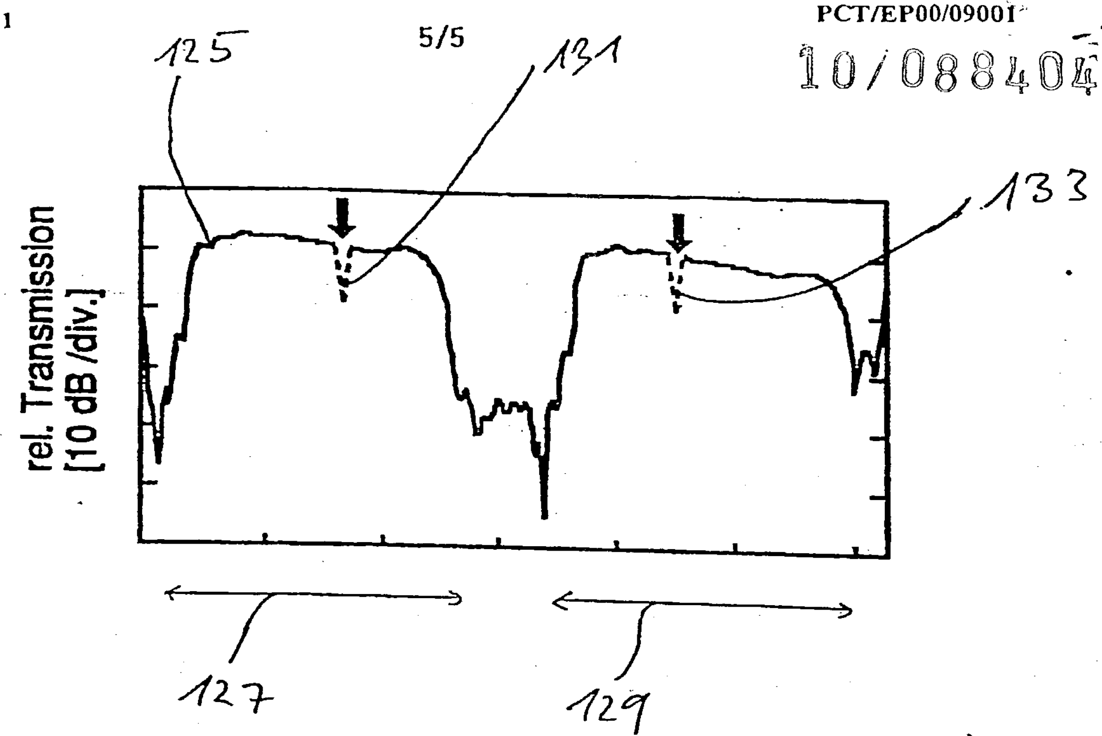

Figure3 b

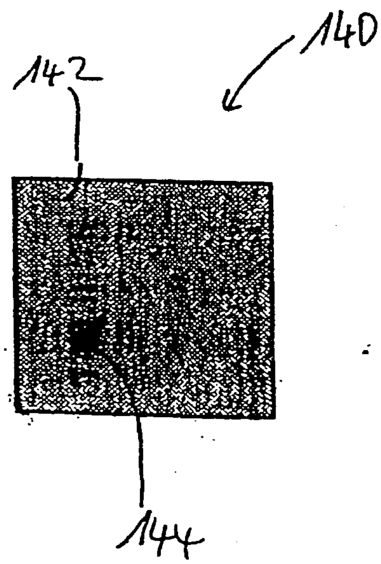

Figure4

10088404 00965-0221 e1

PATENT
Attorney's Docket No. 298-157

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(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CIP)

As a below named inventor, I hereby declare that:

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This declaration is of the following type: *(check one applicable item below)*

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INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

DEVICE AND METHOD FOR HIGH-SENSITIVITY RESOLUTION DETECTION

SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

(a) ☐ is attached hereto.

(b) ☐ was filed on_______________ as ☐ Serial No.____________or ☐ Express Mail No., as Serial No. not yet known _________________ and was amended on ______________ *(if applicable)*.

NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 C.F.R. 1.67.

(c) ☒ was described and claimed in PCT International Application No. PCT/EP00/09001 filed on September 14, 2000 and as amended under PCT Article19 on ________ *(if any)*.

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56, and

☐ in compliance with this duty there is attached an information disclosure statement in accordance with 37 C.F.R. 1.98.

PRIORITY CLAIM (35 U.S.C. §119)(a)-(d)

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d) ☐ no such applications have been filed.

(e) ☒ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. §119(a)-(d)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING *(day, month, year)*	PRIORITY CLAIMED UNDER 35 U.S.C. 119
GERMANY	199 44 452.8	16, 09, 99	☒ YES ☐ NO
PCT	PCT/EP00/09001	14, 09, 00	☒ YES ☐ NO

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S) (34 U.S.C. §119(e))

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PROVISIONAL APPLICATION NUMBER **FILING DATE**

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POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(List name and registration number)*

PETER G. DILWORTH, Reg. No. 26,450; **ROCCO S. BARRESE**, Reg. No. 25,253; **PAUL J. FARRELL**, Reg. No. 33,494; **ADRIAN T. CALDERONE**, Reg. No. 31,746; **GEORGE M. KAPLAN**, Reg. No. 28,375; **MICHAEL E. CARMEN**, Reg. No. 43,533, **HAROLD G. FURLOW**, Reg. No. 43,621; **DANIEL E. TIERNEY**, Reg. No. 33,461; **MICHAEL J. MUSELLA**, Reg. No. 39,310; **JUDY NAAMAT**, Reg. No. 39,311; **MICHAEL R. BREW**, Reg. No. 43,513; **MICHAEL J. PORCO**, Reg. No. 46,007; and **JOHN F. GALLAGHER**, Reg. No. 47,234; each of them of **DILWORTH & BARRESE,LLP**. 333 Earle Ovington Boulevard, Uniondale, New York 11553.

SEND CORRESPONDENCE TO:

Rocco S. Barrese, Esq.
DILWORTH & BARRESE
333 Earle Ovington Boulevard
Uniondale, New York 11553

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

(516) 228-8484

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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NOTE: Carefully indicate the family (or last) name as it should appear on the filing receipt and all other documents.

1)
Full name of **sole or first inventor** Florian Beil
Inventor's signature ×
Date ×28/03/02 Country of Citizenship Germany
Residence Erlerholz 9, 83714 Miesbach, Germany
Post Office Address Same as Above

2)
Full name of **second joint inventor**, if any Martin Streibl
Inventor's signature ×
Date ×02/04/02 Country of Citizenship Germany
Residence Alte Sollerner Strasse 1B, 85238 Petershausen, Germany
Post Office Address Same as above

3)
Full name of **third joint inventor**, if any Achim Wixforth
Inventor's signature ×
Date ×28/03/02 Country of Citizenship Germany
Residence Blutenburgstrasse 43, 80636 München, Germany
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☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor.
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Number of pages added _____.

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☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (CIP) application.
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